

[32] I claim:

1. A method of constructing a composite turbine blade, the method comprising:
  - identifying a turbine blade of continuous compound curvilinear design to be approximated by said composite turbine blade;
  - for discrete base members each having a leading edge and a trailing edge with respect to fluid flow over said base members, each said base member having a first and a second end cut, respectively, at a first and a second angle with respect to said base member leading edge, and each said base member twisted to a third angle such that said leading and trailing edges are not parallel, determining the quantity of said base members, and, for each said base member, the base member length and the first, second, and third angles required to approximate said continuous compound curvilinear turbine blade when said base members are joined end-to-end;
  - cutting a plurality of flat sheets so that each said sheet can be bent to conform to said determined length and said determined first, second, and third angles of a base member;
  - bending said flat sheets into a plurality of bent members so that each has a leading edge, two substantially parallel straight trailing edges, and two open ends;
  - twisting each said bent member to its said determined third angle;
  - before or after said twisting step, joining said two trailing edges of each said bent member into a single trailing edge to form a plurality of prepared blade members; and
  - joining a plurality of said prepared blade members end-to-end to create a composite turbine blade approximating said continuous compound curvilinear turbine blade, said composite turbine blade in cooperation with at least one other substantially matching composite turbine blade being

capable of unidirectionally rotating a turbine about a first axis of rotation under the influence of reversible fluid flow.

2. The method of claim 1 wherein said composite turbine blade has an airfoil cross section.

3. The method of claim 1 wherein said flat sheets are made of metal.

4. The method of claim 1 wherein said flat sheets are made of engineered plastic.

5. The method of claim 1 wherein at least a part of any hollow portion of one or more of said base members is filled.

6. A method of constructing a composite turbine blade, the method comprising:

identifying a turbine blade of continuous compound curvilinear design to be approximated by said composite turbine blade;

for discrete base members each having a leading edge and a trailing edge with respect to fluid flow over said base members, each said base member having a first and a second end cut, respectively, at a first and a second angle with respect to said base member leading edge, and each said base member twisted to a third angle such that said leading and trailing edges are not parallel, determining the quantity of said base members, and, for each said base member, the base member length and the first, second, and third angles required to approximate said continuous compound curvilinear turbine blade when said base members are joined end-to-end;

bending a plurality of flat sheets into a plurality of bent members so that each has a leading edge, two substantially parallel straight trailing edges, and two open ends;

twisting each said bent member to its said determined third angle into a prepared member;

before or after said twisting step, cutting each said bent member so that each said bent member conforms to said determined length and said determined first and second angles of said base member;

before or after said twisting and cutting steps, joining said two trailing edges of each said bent member into a single trailing edge to form a plurality of prepared blade members; and

joining a plurality of said prepared blade members end-to-end to create a composite turbine blade approximating said continuous compound curvilinear turbine blade, said composite turbine blade in cooperation with at least one other substantially matching composite turbine blade being capable of unidirectionally rotating a turbine about a first axis of rotation under the influence of reversible fluid flow.

7. The method of claim 6 wherein said composite turbine blade has an airfoil cross section.
8. The method of claim 6 wherein said flat sheets are made of metal.
9. The method of claim 6 wherein said flat sheets are made of engineered plastic.
10. The method of claim 6 wherein at least a part of any hollow portion of one or more of said base members is filled.
11. A method of constructing a composite turbine blade, the method comprising:  
identifying a turbine blade of continuous compound curvilinear design to be approximated by said composite turbine blade;

for discrete base members each having a leading edge and a trailing edge with respect to fluid flow over said base members, each said base member having a first and a second end cut, respectively, at a first and a second angle with respect to said base member leading edge, and each

said base member twisted to a third angle such that said leading and trailing edges are not parallel, determining the quantity of said base members, and, for each said base member, the base member length and the first, second, and third angles required to approximate said continuous compound curvilinear turbine blade when said base members are joined end-to-end;

extruding a plurality of members having said leading and trailing edges, said leading and trailing edges being closed to form a plurality of extruded members;

cutting said extruded members to form a plurality of prepared extruded members so that each said prepared extruded member conforms to said determined length and said determined first and second angles of said base member;

before or after said cutting step, twisting each said extruded member to its said determined third angle to form a plurality of prepared blade members;

joining a plurality of said prepared blade members end-to-end to create a composite turbine blade approximating said continuous compound curvilinear turbine blade, said composite turbine blade in cooperation with at least one other substantially matching composite turbine blade being capable of unidirectionally rotating a turbine about a first axis of rotation under the influence of reversible fluid flow.

12. The method of claim 11 wherein said composite turbine blade has an airfoil cross section.
13. The method of claim 11 wherein said flat sheets are made of metal.
14. The method of claim 11 wherein said flat sheets are made of engineered plastic.
15. The method of claim 11 wherein at least a part of any hollow portion of one or more of said base members is filled.

16. A method of constructing a prepared turbine blade, the method comprising:

identifying a turbine blade of continuous compound curvilinear design to be approximated by said prepared turbine blade constructed from a continuous extrusion formed into discrete straight sections;

for discrete base sections each having a leading edge and a trailing edge with respect to fluid flow over said base sections, each said base section having a first and a second end angle with respect to said base section leading edge, and each said base section twisted to a third angle such that said leading and trailing edges are not parallel, determining the quantity of said base sections, and, for each said base section, the base section length and the first, second, and third angles required to approximate said continuous compound curvilinear turbine blade;

extruding a member having said leading and trailing edges;

twisting the said extruded member to its said determined first, second, and third angles to form a prepared turbine blade approximating said continuous compound curvilinear turbine blade, said prepared turbine blade in cooperation with at least one other substantially matching prepared turbine blade being capable of unidirectionally rotating a turbine about a first axis of rotation under the influence of reversible fluid flow.

17. The method of claim 16 wherein said composite turbine blade has an airfoil cross section.

18. The method of claim 16 wherein said flat sheets are made of metal.

19. The method of claim 16 wherein said flat sheets are made of engineered plastic.

20. The method of claim 16 wherein at least a part of any hollow portion of one or more of said base members is filled.

21. A turbine having one or more blades constructed of discrete straight members of uniform cross section that are joined to approximate a turbine blade of continuous compound curvilinear design.
22. A turbine having one or more blades constructed of a continuous member of uniform cross section formed into discrete straight sections so that said formed continuous member approximates a turbine blade of continuous compound curvilinear design.
23. The turbine of claim 21 wherein for any adjacent first and second turbine blades, a portion of said first turbine blade that connects with a first end of said turbine axis of rotation lies in the same position with respect to said turbine axis of rotation as a portion of said second turbine blade that connects with said second end of said turbine axis of rotation.
24. The turbine of claim 22 wherein for any adjacent first and second turbine blades, a portion of said first turbine blade that connects with a first end of said turbine axis of rotation lies in the same position with respect to said turbine axis of rotation as a portion of said second turbine blade that connects with said second end of said turbine axis of rotation.
25. The turbine of claim 21 having turbine blades wherein any cross section of said turbine blades perpendicular to said turbine axis of rotation is tangential, within an approximate plus or minus six degree range, to a circular plane containing said cross section and a turbine diameter.
26. The turbine of claim 22 having turbine blades wherein any cross section of said turbine blades perpendicular to said turbine axis of rotation is tangential, within an approximate plus or minus six degree range, to a circular plane containing said cross section and a turbine diameter.

27. The turbine of claim 21 wherein a straight line joining the centers of pressure of each cross section of any said discrete straight member does not lie in any plane containing said turbine axis of rotation.

28. The turbine of claim 22 wherein a straight line joining the centers of pressure of each cross section of any said discrete straight section does not lie in any plane containing said turbine axis of rotation.

29. A turbine having one or more blades constructed of discrete straight members, some members having a nonuniform cross section that increases as proximity to said turbine axis of rotation decreases.

30. The turbine of claim 21 wherein the fluid activating the turbine is water.

31. The turbine of claim 22 wherein the fluid activating the turbine is water.

32. A method of constructing a composite turbine blade, the method comprising:  
identifying an airfoil-shaped helical turbine blade to be approximated by said composite turbine blade;

for discrete airfoil-shaped base members each having a leading edge and a trailing edge as commonly recognized in the aeronautical industry, each said base member having a first and a second airfoil-shaped end cut, respectively, at a first and a second angle with respect to said base member leading edge, and each said base member twisted to a third angle such that said leading and trailing edges are not parallel, determining the quantity of said base members, and, for each said base member, the base member length and the first, second, and third angles required to approximate said helical turbine blade when said base members are joined end-to-end;

cutting a plurality of flat metal sheets so that each said sheet can be bent to conform to said determined length and said determined first, second, and third angles of said base member;

bending said flat metal sheets into a plurality of said base blade members so that each has a curvilinear leading edge, two substantially parallel straight trailing edges, and two open, airfoil-shaped ends;

twisting each said base member to its said determined third angle;

joining said two trailing edges of each said base member into a single trailing edge to form a plurality of prepared blade members;

joining a plurality of said prepared blade members end-to-end to create a composite turbine blade with an approximate helical shape, said composite turbine blade in cooperation with at least one other substantially matching composite turbine blade being capable of unidirectionally rotating a turbine about a first axis of rotation under the influence of reversible fluid flow.

33. A turbine having one or more composite turbine blades constructed according to claim 32.

34. A method of constructing a composite turbine blade, the method comprising:

identifying an airfoil-shaped troposkein turbine blade to be approximated by said composite turbine blade;

for discrete airfoil-shaped base members each having a leading edge and a trailing edge as commonly recognized in the aeronautical industry, each said base member having a first and a second airfoil-shaped end cut, respectively, at a first and a second angle with respect to said base member leading edge, and each said base member twisted to a third angle such that said leading and trailing edges are not parallel, determining the quantity of said base members, and, for each said base



member, the base member length and the first, second, and third angles required to approximate said troposkein turbine blade when said base members are joined end-to-end;

cutting a plurality of flat metal sheets so that each said sheet can be bent to conform to said determined length and said determined first, second, and third angles of said base member;

bending said flat metal sheets into a plurality of said base members so that each has a curvilinear leading edge, two substantially parallel straight trailing edges, and two open, airfoil-shaped ends;

twisting each said base member to its said determined third angle;

joining said two trailing edges of each said base member into a single trailing edge to form a plurality of prepared blade members;

joining a plurality of said prepared blade members end-to-end to create a composite turbine blade with an approximate troposkein shape, said composite turbine blade in cooperation with at least one other substantially matching composite turbine blade being capable of unidirectionally rotating a turbine about a first axis of rotation under the influence of reversible fluid flow.

35. A turbine having one or more composite turbine blades constructed according to claim 34.